

Electrogram Features are Superior to Clinical Characteristics for Predicting Atrial Fibrillation After Coronary Artery Bypass Graft Surgery

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Background: Atrial fibrillation (AF) occurs in approximately 30% of coronary artery bypass graft (CABG) patients following surgery, increasing cost and morbidity. We hypothesized that quantitative features extracted from the surface ECG and atrial wire tracing could predict the risk of AF after CABG.

Methods: Patients were monitored with continuous Holter recordings from surface lead II and intracardiac right atrial electrograms for 48 hours following CABG. A single five-minute segment of ECG at 36 hours following surgery was extracted for analysis. P waves and QRS complexes were annotated and used to extract ECG segments (RR,RP,PR,PP) and heart rate variability measures from which 536 temporal, frequency, and nonlinear domain features were calculated. An evolutionary computing technique was used to train a k-Nearest-Neighbor (kNN) classifier to determine the best features to assess AF risk. For comparison, the patients' age, history of AF, beta-blocker withdrawal, and the presence of pulmonary disease were used as inputs to a linear AF risk score. An AF prediction threshold was assigned as the maximum of the product of the sensitivity and specificity as found on the data's receiver operating characteristic curve.

Results: Thirty-three patients (21 male, 11 with post-operative AF) were studied. The trained kNN classifier identified two variables, the skewness of heart rate and the minimum of the RP segment's median frequency as predictors of post-operative AF. The algorithm, validated using a leave-one-out methodology, correctly classifies 90.9% (30 of 33) patients, with a sensitivity of 82% and a specificity of 96%. The clinical AF risk score produced an accuracy of 63.6% (21 of 33), significantly inferior to the kNN classifier.

Conclusion: Two combined indicators, based on surface and intracardiac electrogram, skewness of heart rate and the minimum of the RP segment's median frequency, were superior to clinical characteristics for predicting AF after CABG. These findings, if validated prospectively, may be important for identifying patients at risk of developing AF after CABG.